$$\left.\begin{array}{l}\text{Distance } a = 0''{\cdot}66\\ \quad ,,\quad b = 1{\cdot}70\\ \quad ,,\quad c = 0{\cdot}84\end{array}\right\}\text{ November 3.}$$

$$\left.\begin{array}{l}\text{Distance } a = 0{\cdot}74\\ \quad ,,\quad b = 1{\cdot}66\\ \quad ,,\quad c = 1{\cdot}03\end{array}\right\}\text{ November 6.}$$

Assuming 0·1705 and 0·1714 to be log. Δ on those days respectively, the distance a would be about 4000 miles, the distance b about 10000 miles, and the distance c about 5500 miles.

It would not be surprising, judging from the history of this comet, if another condensation developed in the portion of the coma nearest the sun, thus forming four nucleuses.

W. T. SAMPSON,
Commander U.S.N.

Naval Observatory, Washington, November 11

Since my first communication, with sketch of the comet, on October 21, which appeared in NATURE, vol. xxvi. p. 622, I have had good views on 21 out of 31 days. The fine weather and clear atmosphere of this place give exceptional facilities for the continued and frequent observations which are needed to obtain a knowledge of so anomalous and surprising an object. Some windows of my villa command an extensive sky and sea view (including at times the mountains of Corsica, 120 miles distant), and from my bedroom—sometimes even from my bed—I have been able to watch the comet with ease for from a quarter of an hour to an hour, on each of those twenty-one days; using only a good field binocular in occasional aid of a strong natural sight. I have more powerful telescopes, but for this object they give no help; and I am not astronomer enough to avail myself of other instruments.

The comet was seen in all its brightness on October 20, 21, 23, and 24, with its nucleus like a star of first magnitude, but elongated and nebulous—its tail beginning with slender stem, slightly curved, with downward convexity, and gradually expanding to its extremity, the diameter of which was about five times that of the head. The lower, slightly convex margin, was brighter, and more defined; but a strong nebulous light pervaded the length and breadth of the tail, shaded along the upper margin in gradually diminishing haze. The tail ended in an elongated crescent, the lower or eastern horn of which was longer than the other. Both horns were prolonged in faint lines, hardly perceptible, a few degrees further (as noticed by your correspondent, Mr. Larden). No such prolongation could be seen from the hollow of the crescent, which terminated by a narrow fringe of diminishing light, beyond which was an oval patch of shade, *obviously darker than any other portion of the visible sky.* This appeared to me nothing else than a *shadow* projected by the comet on the space beyond the end of its tail. I cannot admit the correctness of Major Herschel's *suspicions*, "that this impression was produced by contrast only" (NATURE, vol. xxvii. p. 4). The still greater contrast between the brightness of the lower margin and the adjoining sky produced no such shade there *at that time*: later I shall allude to such a shade appearing there also. The ultra-caudal patch was obviously darker than any other spot of the sky: so it appeared to me, and my experience in landscape painting has given me some skill in appreciating lights and shades. I am quite aware of the difficulty of physically explaining the existence of light and shadow in the vacuity of space, but this is a question of pure observation, to which I invite further attention. Two of your correspondents, Mr. Larden of Cheltenham, and Mr. Cecil of Bournemouth, describe "a black rift in the sky," and "a strong apparent shadow" behind the comet—seemingly in confirmation of my observation.

When the comet was next seen, after an interval of bad weather, on the 29th it had lost in dimensions, but still more in brightness, and its form was changed. The upper margin from the head upwards had expanded and become more feathery; so had the end of the tail, which had lost its crescentic form; the shadow beyond had quite disappeared, and was replaced by an ill-defined luminosity, losing itself in the darkness of the sky. The lower margin of the tail had lost less of its brightness and definition; and now if there was a shadow anywhere, it was along this edge, down even to the head of the comet; but the shade was much less marked than had been that beyond the tail, and I might have ascribed it to contrast but that it was not present when this margin was brighter and the contrast greater. This shadow is noticed by Mr. Cecil in NATURE, vol. xxvii. p. 52.

The comet was well seen on October 30 and 31, and November 2, 3, 4, 6, and 7, gradually diminishing in brightness and in the definition of its outline, its light being now further paled by moonlight. So faint was it that I am not surprised at Major Herschel's description of its non-appearance in the London sky of November 5; but I cannot help "suspecting" that this was due not to moonlight only (as the testimony of others proves), but also to the gas-lit haze of the London atmosphere, which from fifty years' experience I know to be, at its clearest, quite sufficient to mask a faded comet, even although the brighter light of stars may still remain visible. On the 8th the comet was seen before moonrise, more distinct, although pale and hazy in outline; lower margin still the brightest, with a slight attendant shade. It was seen every day (except the 13th, 14th, and 15th) until the 22nd, with little other changes than that it was gradually becoming fainter, although still a conspicuous object in the dark sky from 2 to 5.30 a.m. On the 21st I made a careful portrait of it in oils, with its attendant stars, by the side of one that I had painted from the sketch taken October 21, when it was in its glory. The alteration which has taken place in the month is such that it now seems the mere ghost of its former self. The comparison strikes one as showing how much more it has lost in brightness and compactness, than in length and breadth. Is not this in exact conformity with what has been ascertained (see NATURE, vol. xxvii. p. 58) that the comet has been receding more rapidly from the sun than from the earth.

C. J. B. WILLIAMS

Cannes, November 23

THE APPROACHING ECLIPSE OF MAY 6, 1883[1]

THE sixth of May next year will witness, in the distant regions of Oceania, one of the rarest and most important astronomical phenomena of the century, viz. a total eclipse of the sun, which, owing to the respective positions, but rarely realised, of the sun and the moon, will have a duration quite extraordinary.

Now, in the present state of science, when the most important questions as to the constitution of the sun and that of the unexplored spaces near him, and the existence of those hypothetical planets which Le Verrier's analysis indicated within the orbit of Mercury, are still pending, a phenomenon which presents to us, for long minutes, all those regions, with the sun's dazzling brilliancy withdrawn, and renders them accessible to observation, is one of the first order.

We shall presently examine the conditions under which this rare solar occultation will be produced; let us first see what is the state of the questions which have to be considered on this occasion. One of the most important is that regarding the constitution of the space immediately bordering on the envelopes of the sun at present known.

The great Asiatic eclipse of 1868, came wonderfully *à propos*, both by its long duration and by the maturity of the problems that had to be attacked, enabled us in some sort to tear the veil which hid from us the phenomena existing beyond the visible surface of the sun. It was then that was solved the enigma so long pondered over regarding the nature of those roseate protuberances which surround in such a singular way the limb of the eclipsed sun.

---

[1] Report to the Bureau des Longitudes, by a Commission consisting of MM. Fizeau, Admiral Cloué, Lœwy, and Janssen (reporter).

Spectral analysis taught us that they were immense appendages belonging to the sun, and formed almost exclusively of incandescent hydrogen gas. Almost immediately, the method suggested by this same eclipse, and which allows of a daily study of those phenomena, revealed the relations of those protuberances to the solar globe. It was perceived that the protuberances are merely jets, expansions of a layer of gas and vapours, 8″ to 12″ in thickness, where the hydrogen preponderates, and which is at a very high temperature, by reason of its contact with the surface of the sun. This low atmosphere is the seat of frequent eruptions of vapours coming from the solar globe, and among which one chiefly observes sodium, magnesium, and calcium. We may even suppose that, in the lowest part of this *chromosphere*, as it has been called, most of the vapours, which in the solar spectrum, produce the dark lines it presents, exist in the state of high incandescence.

The eclipse of 1869, which was visible in America, allowed indeed of the important observation (always confirmed since) of the reversal of the solar spectrum at the extreme border of the disc, that is to say, at the points where the photosphere is immediately in contact with the chromosphere; a phenomenon which does not signify that the photosphere itself may not contain the same vapours and concur in the production of the solar spectral lines.

Thus the discovery of a new solar envelope, the recognised nature of the protuberances, and the knowledge of their relation to the sun; lastly, the conquest of a method for the daily study of those phenomena; such were the fruits of spectrum analysis applied to the study of this long eclipse of 1868.

But a total eclipse presents other manifestations completely unexplained up to the time of which we speak. There is seen, beyond the protuberances and the chromospheric ring, a magnificent aureole, or luminous corona, of soft brightness and silvery tint, which may reach as far as an entire radius of the dark limb of the moon.

The study of this beautiful phenomenon, by methods which had given such magnificent results, was immediately undertaken, and occupied the astronomers during the eclipses of 1869, 1870, and 1871.

But the aureole or corona, though constituting a brilliant phenomenon, has in reality but weak luminous power. Hence the difficulty of obtaining its spectrum with its true characters. Thus the astronomers differed at first as to the real nature of the phenomenon. In 1871, and by the use of an extremely luminous instrument, it was definitively proved that the spectrum of the corona contains the bright lines of hydrogen, and the green line called 1474 of Kirchhoff's maps, an observation which demonstrates that the corona is a real object constituted of luminous gases forming a third envelope round the solar globe.

If indeed the phenomenon of the corona were a simple phenomenon of reflection or of diffraction, the coronal spectrum would merely be a weakened solar spectrum. On the other hand, the characters of the solar spectrum are here quite subordinate, and the spectrum is that of protuberantial gases and of matter still unknown, indicated by the line 1474.[1]

The subsequent eclipses of 1875 and 1878, and that recently observed in Egypt, have yielded confirmation of these results.

But if the constitution of the sun is being thus rapidly unveiled, there still remain great problems to be solved, both as to this last solar envelope, and as to the region near it.

First of all, have the immense appendices which the corona has presented during some eclipses, an objective reality, and are they a dependance of this immense coronal atmosphere, or might they rather be streams of meteorites circulating round the sun (as one of the members of the Bureau has suggested)?

We do not forget the zodiacal light, the relations of which to those dependances of the sun remains to be determined.

But these problems are not the only ones we have now to attack, during the occultations of the solar globe. Do the regions with which we are occupied contain one or several planets, which the illumination of our atmosphere, so bright in the neighbourhood of the sun, may have always concealed from us? Leverrier long studied this question, and his analytical researches led him to suppose their existence.

On the other hand, several observers have alleged that they have observed transits of round and dark bodies in front of the sun; but these observations are far from being certain. The surface of the sun is often the seat of small, very round spots, which appear and disappear in a time often short enough to simulate the passage of round bodies before that star.

The question is of capital importance; hence it at present justly engages the thoughts of all astronomers.

May the analysis of Leverrier enrich the solar world towards its central regions, as it has done with such a magnificent success in the most distant regions?

We have but two means of solving the problem, whose solution is more particularly incumbent on French astronomy; the attentive study of the solar surface, or the examination of the circumsolar region when an eclipse renders their exploration possible to us. This last means seems the most efficacious, but on the condition that the occultation is long enough to allow of a minute exploration of all the regions where the small star may be met with.

This gives a capital importance to the eclipse of May 6 next, one of the longest of the century.

We will now examine the circumstances of this great eclipse, and the means that it would be well to employ for observation of it.

The total eclipse of May 6 next will have a duration of 6 minutes at the point where the phase is maximum (5m. 59s.); a time triple that of ordinary eclipses.

The central line is wholly comprised in the South Pacific Ocean, and we can only hope to observe it in the islands of that ocean.

After an attentive study of the question, it has appeared to us that two islands would do about equally well for observation; those of Flint and Caroline.

Flint Island (lat. 11° 30′ S., and long. 151° 48′ W. of Greenwich) is the nearest to the central line. Calculation gives for the duration of totality in this island 5m. 33s. Caroline Island is 150° 6′ W., and 9° 50′ S.; the duration of the totality there will be 5m. 20s.; that is, only 13 seconds less than in Flint Island.

It will be seen that the astronomical conditions of the phenomenon are extremely favourable in these islands, and it is to these stations we should propose to the Bureau to send an expedition.

This expedition should start from Paris, go to New York, traverse the American Continent by the railway to San Francisco, and there find a steamer (of a French service about to be established), which should carry it to the Marquesas Islands. There a man-of-war of the French station should take it up, and deposit one portion at Caroline Island, the other at Flint Island. This ship which, further, should be provided with all that is necessary for the establishment of the stations, the safety and the subsistence of the observers, should not leave those regions before bringing the mission to Tahiti, where our *envoyés* would find means of transport for their return, either by the way they went, or (which would seem preferable), by way of Australia.

---

[1] One of us has expressed the idea (Notice du Bureau des Longitudes, 1879) that the coronal atmosphere which is in dependence on the chromosphere and photosphere must present a much more agitated appearance at the epoch of maximum of spots and protuberances, since the jets of hydrogen which then penetrate it are much more numerous and rich Ulterior observations, and especially those which have been made during the last eclipse at the moment when the solar eruptions were abundant, have confirmed this prevision.

THE TRANSIT OF VENUS ON WEDNESDAY, DECEMBER 6

AT the Transit of Venus in 1874 the tables of the planet prepared by Prof. Hill appeared to have a decided advantage over those of Leverrier. The correction to the tabular place deduced from the observations of the transit is in close accordance with that shown by a meridian observation at Washington on the day preceding the phenomenon. Although the entire discordance was not negatived by the tables of Prof. Hill, they went far towards removing it in 1874, and as the coming transit (December 6) will take place in nearly the same point in the planet's orbit, we shall assume in what follows, that the tables of the American astronomer will again be fairly correct. Prof. Newcomb assumes and probably with much reason, that the error of Leverrier's tables will prove to be an increasing one, and is therefore inclined to apply a still larger correction to the place deduced from them. It may be mentioned that the calculations of the transit in the *Nautical Almanac*, the *Connaissance des Temps*, and the *Berliner Astronomisches Jahrbuch*, depend upon Leverrier's tables. For the diameter of the planet we adopt that found by Prof. Auwers from heliometric measures in Egypt during the last transit, combining it with the diameter of the sun, inferred by Leverrier from his discussion of the transits of Mercury.

Direct calculations for Greenwich, Edinburgh, and Dublin give with the elements so obtained the following *Greenwich* mean times of the first external contact, and the respective angles from the sun's vertex for direct image :—

	h. m. s.		° ′
Greenwich	2 0 42·2	... ...	126 59·4
Edinburgh	2 1 7·7	... ...	130 49·3
Dublin	2 1 9·6	... ...	131 21·2

For a limited area like that of these islands we may apply to these times and angles, the method of distribution of predictions given by Littrow, and subsequently by Woolhouse. Putting the latitude of any place within the above area = 50° + L, and its longitude in minutes of time = M, + if *east* of Greenwich, − if *west*, we get the following equations :—

G.M.T. of first external contact ... } = 2h. 0·62m. + [8·7453] L − [8·1402] M.

Angle from sun's vertex, direct image... } = 126°·3 + [9·669] L − [9·136] M.

The quantities within the square brackets are logarithms, but of course if preferred the factors for L and M may be expressed as numbers. As an example of the application of these formulæ, suppose the time of first contact and the corresponding angle are required for Norwich, the position of which place may be taken in latitude + 52° 38′, longitude 1° 18′ or + 5m. 12s., we have then

L = + 2°·633 M = + 5·20m.

	+ 8·7453		− 8·1402
Log. L ...	+ 0·4205	Log. M ...	+ 0·7160
	+ 9·1658		− 8·8562
No.	+ 0·146	No.	− 0·072
	− 0·072		
	2 0·62		

		h. m. s.	
2 0·69	or	2 0 41	G.M.T.
Longitude E		5 12	
		2 5 53	Norwich M.T.

For the angle—

	+ 9·669		− 9·136	+ 1°·23
Log. L	+ 0·421	Log. M	+ 0·716	− 0·71
				126·3
	+ 10·090		− 9·852	126·8 ... angle from vertex.

So that according to the calculation the limb of the planet comes into first contact with that of the sun at 53° from his lowermost point towards the left, as we view the phenomenon with the naked eye. It will be remarked that there is less than a half minute difference in absolute time between Greenwich and Dublin, and considering the possibility of error of many seconds in any prediction that can be made for geometrical contact and the difficulty of always determining what is geometrical contact in the observations, our formula for time of first contact is more than a sufficient one.

For first *internal* contact, it may be assumed that 21 minutes have to be added to the time of external contact at any place in these islands; while for the angle from N. point of first external contact may be taken in all cases 147°.

In the national ephemerides the times of the contacts are given for a particular meridian as they would be noted at the centre of the earth, and formulæ are appended to reduce these geocentric times to any point upon the earth's surface. It is obvious that where, as in a transit of Venus, predictions are required for such widely distant stations, this method possesses the greatest convenience.

NOTES

THE following are the Lecture arrangements at the Royal Institution for the ensuing Session :—The Christmas Lectures will be given by Prof. Tyndall, on Light and the Eye. Before Easter—Prof. W. C. Williamson on the Primeval Ancestors of Existing Vegetation, and their Bearing upon the Doctrine of Evolution; Prof. R. S. Ball, four lectures on the Supreme Discoveries in Astronomy; Prof. Dewar, nine lectures on the Spectroscope and its Applications; Mr. R. Bosworth Smith, four lectures on Episodes in the Life of Lord Lawrence; Dr. W. H. Stone, three lectures on Singing, Speaking, and Stammering; Mr. H. H. Statham, two lectures on Music as a Form of Artistic Expression. After Easter—Courses will be given by Professors Tyndall, McKendrick, A. Geikie, and Turner (of St. Petersburg). The Friday Evening Discourses will probably be given, among others, by Mr. R. B. Smith, Dr. G. J. Romanes, Sir W. Thomson, Mr. M. D. Conway, Prof. W. C. Williamson, Mr. W. H. Pollock, and Prof. Tyndall.

A COMMITTEE, consisting of the Right Hon. J. T. Ball, LL.D., D.C.L., the Very Rev. W. Reeves, D.D., Dean of Armagh, J. L. E. Dreyer, Ph.D., Astronomer of Armagh Observatory, has been appointed by the Governors of the Armagh Observatory to raise a fund for the purpose of erecting a memorial instrument in the observatory at Armagh, where the late Rev. Dr. Robinson spent fifty-eight years, engaged in those scientific investigations with which his name will be for ever associated. The Committee addresses its appeal not only to the inhabitants of Ulster, or of Dublin, but to Robinson's friends and admirers all over the United Kingdom. The services rendered to astronomy by Dr. Robinson are well known, and doubtless many of our readers will be glad to aid in paying a tribute to his memory. It is proposed that the memorial take the form of an equatoreal refractor, say of eight or nine inches aperture, which could be had for about 500*l.*, and could find room in one of the existing domes at Armagh. With such an instrument, much valuable and interesting work could be done. Subscriptions should be sent to Dr. J. L. E. Dreyer, Observatory, Armagh.